If you are using a printed copy of this procedure, and not the on-screen version, then you MUST make sure the dates at the bottom of the printed copy and the on-screen version match.
The on-screen version of the Collider-Accelerator Department Procedure is the Official Version.
Hard copies of all signed, official, C-A Operating Procedures are kept on file in the C-A ESHQ Training Office, Bldg. 911A.

C-A OPERATIONS PROCEDURES MANUAL

8.3 Procedure For Operating S.C. Magnet for Polarized Ion Source At LINAC

Text Pages 2 through 7

Hand Processed Changes

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Approved: _____***Signature on File***_____ _____
Collider-Accelerator Department Chairman Date

L. Jia

8.3 Procedure for Operating S.C. Magnet for Polarized Ion Source at LINAC

1. Purpose

To provide instructions for system operators to ensure safe operation of the superconducting magnet.

2. Responsibilities

2.1 The LINAC Group is responsible for the installation, maintenance, and operation of the SC magnet.

2.2 The LINAC Supervisor is responsible for assigning qualified operator to conduct this procedure.

3. Prerequisites

3.1 Qualified and trained operators in ODH and in Cryogenics.

3.2 The minimum number of persons required to conduct this procedure is TWO.

4. Precautions

4.1 Use protective gloves and eyeglasses. Cold helium gas venting from the service port area can cause severe frostbite on exposed skin.

4.2 Adequate ventilation in the room is required to prevent asphyxiation from the helium gas venting.

4.3 Low oxygen alarm must be installed and in function in the operation room.

5. Procedure

5.1 Prepare instruments and equipment according to following list

5.1.1 Vacuum pumps and hoses.

5.1.2 LN2 dewar (~200 liters).

5.1.3 LN2 transfer lines (vacuum jacketed or Teflon hoses).

5.1.4 GHe pressure bottles.

5.1.5 LHe dewar (~200 liters).

5.1.6 LHe vacuum jacketed transfer lines.

5.1.7 LHe level meter.

5.1.8 Polarized power supply.

5.1.9 Electrical power leads.

5.2 Pump thermal insulation space

5.2.1 Set-up pumping system according to Fig. 1.

5.2.2 Pump thermal insulation space through the Vacuum Gate Valve.

5.2.3 Target vacuum: $<1x10^{-4}$ torr.

5.2.4 Check leak rate: $<1x10^{-8}$ torr-l/s.

5.3 LN2 pre-cooling of the helium reservoir

5.3.1 Connect LN2 dewar to helium vessel of service dewar with LN2 transfer hose according to Fig. 2.

5.3.2 Adjust LN2 dewar pressure at 0.2 ~ 0.5 barg (attach a GN2 or GHe bottle if necessary).

5.3.3 Run GN2 exhaust through venting pipe with MV1 closed and MV2 open.

5.3.4 Stop LN2 cooling at coil temperature of 80 K on temperature sensor CC6.

Caution

Cooling rate must be controlled so that it is less than 0.5 K/min. Fast cooling rate may damage the magnet because of the increasing of thermal stress in coil winding.

5.4 Start-up cryocooler

5.4.1 Connect gas hoses and control cable between He compressor and cold-head according to Fig. 3.

5.4.2 Run cooling water for compressor at the flow rate of 6~6.5 ltr/min.

5.4.3 Check the static helium pressure in compressor at HP and LP pressure gages at 280~295 psig.

5.4.4 Start He compressor and check pressure for HP: 280~350 psig and LP: 75~160 psig.

5.5 LN2 pre-cooling of the heat shields

5.5.1 Connect LN2 dewar to LN2 shield-cooling-port according to Fig. 4.

5.5.2 Apply a hose-jumper between two shield cooling circuits.

5.5.3 Adjust LN2 dewar pressure at 0.5 ~ 1.0 barg.

5.5.4 Stop LN2 cooling at shield temperature of 80K on temperature sensor CC3, CC4,and CC5.

5.6 Pump/purge of helium reservoir

5.6.1 Connect vacuum pump and GHe bottle according to Fig. 5.

5.6.2 Pump and purge helium reservoir three times at target vacuum of 10^{-2} torr and purge pressure of 0.5 barg at each time.

5.7 LHe filling of helium reservoir

5.7.1 Connect LHe dewar to helium reservoir according to Fig. 6.

5.7.2 Adjust LHe dewar pressure at 0.1 ~ 0.2 barg.

5.7.3 Purge LHe transfer line before inserting it into He reservoir.

5.7.4 Stop transferring when LHe level reads full (100%).

5.8 Close and secure thermal insulation vacuum gauge

5.8.1 Check the target vacuum reading < 10^{-5} torr.

5.8.2 Close and lock the Vacuum Gate Valve.

5.8.3 Shut down and secure the vacuum pump.

Caution

Do not move the valve handle once the valve is closed. Incorrect position can cause vacuum loss that can lead to quench when magnet is charged and large amount of cold GHe venting may cause asphyxiation and/or frostbite.

5.9 Charging the magnet

Warning 1:

When connecting the power cords to the power leads, make sure the polarity is correct. If the positive and negative poles are reversed, the magnet can quench.

Warning 2:

While inserting the power lead into the service port, avoid facing the venting port for the leads and prevent frostbite on exposed skin.

Warning 3:

While inserting the power lead into the service port, do not touching the two exposed electrodes. An extreme electrical shock can occur during a quench.

Caution 1:

LHe level must read above 30%. Refill if necessary.

Caution 2:

Clear all magnetic materials around the magnet.

5.9.1 Connect the power cords to the power lead according to Fig. 7.

5.9.2 Release the pressure of the LHe reservoir by opening MV1.

5.9.3 Purge the current lead using GHe for 3 minutes at GHe pressure of 0.1 ~ 0.5 barg.

5.9.4 Slowly insert the current lead into the service port. This process should take at least 5 minutes.

5.9.5 Charge the magnet by trained and authorized operator.

5.9.6 Remove electrical power from the load. Detach the power lead and re-cap the service port (use hot air gun to defrost ice at the port if necessary).

5.10 Refilling LHe reservoir

5.10.1 Connect LHe dewar to helium reservoir according to Fig. 6.

5.10.2 Adjust LHe dewar pressure at 0.1 ~ 0.2 barg.

5.10.3 Pre-cool the LHe transfer line before refilling.

Warning
Before transferring liquid helium into the magnet, the transfer line must be properly pre-cooled to prevent a quench if magnet is charged.

5.10.4 Fully open MV1 for GHe venting.

5.10.5 Insert the transferline all the way to LHe reservoir and lift it 5~10mm from the bottom and then fix the position by the gutter nut.

5.10.6 Transfer LHe until 100% full.

5.10.7 Remove the transfer line and cap the port.

6. Documentation

None

7. Reference

"Cryogenic System Description of Superconducting Magnet for Polarized Ion Source at LINAC", Li Wang and Lin X. Jia, October 20, 1999

8. Attachments

8.1 List of the relief valves and manual valves as shown on Figures 1 through 7.

8.2 Figure 1. Schematic for vacuum space pumping.

8.3 Figure 2. Schematic for LN2 pre-cooling of SC magnet.

8.4 Figure 3. Schematic for heat shield cooling using cryocooler.

8.5 Figure 4. Schematic for heat shield cooling using LN2.

8.6 Figure 5. Schematic for pumping/purging He reservoir.

8.7 Figure 6. Schematic for transferring LHe to SC magnet.

8.8 Figure 7. Schematic for charging magnet.

Table 1. List of the relief valves and manual valves

Name	Description	Size	Pressure Rating
RV1	Spring Load Relief Valve	ᴿı6.35 mm	0.07 barg
RV2	Spring Load Relief Valve	8 x ᴿı10 mm	0.5 barg ∀ 10%
RV3	Rupture Disc	ᴿı50 mm	1.0 ∀ 0.15 barg @ 20 K
RV4	Vacuum Relief Valve	ᴿı40 mm	0.14 barg
MV1	Manual Ball Valve	ᴿı9.5 mm	> 60 barg
MV2	Manual Ball Valve	ᴿı9.5 mm	> 60 barg

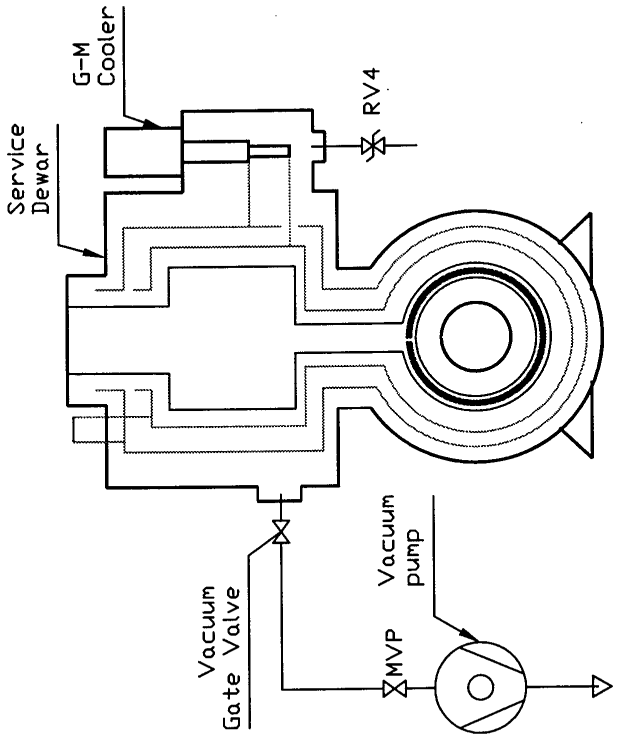

Figure 1
Schematic for Vacuum Space Pumping

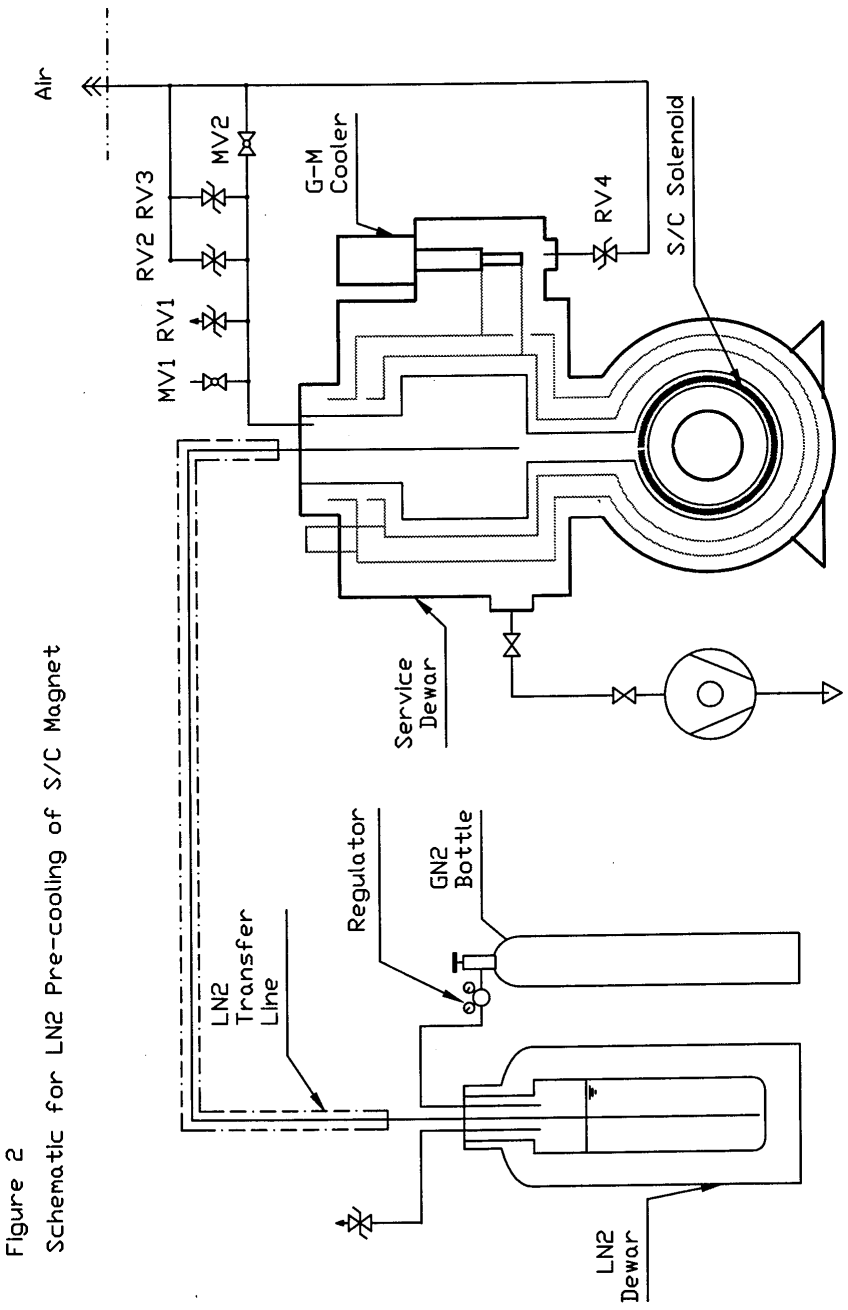

Figure 2
Schematic for LN2 Pre-cooling of S/C Magnet

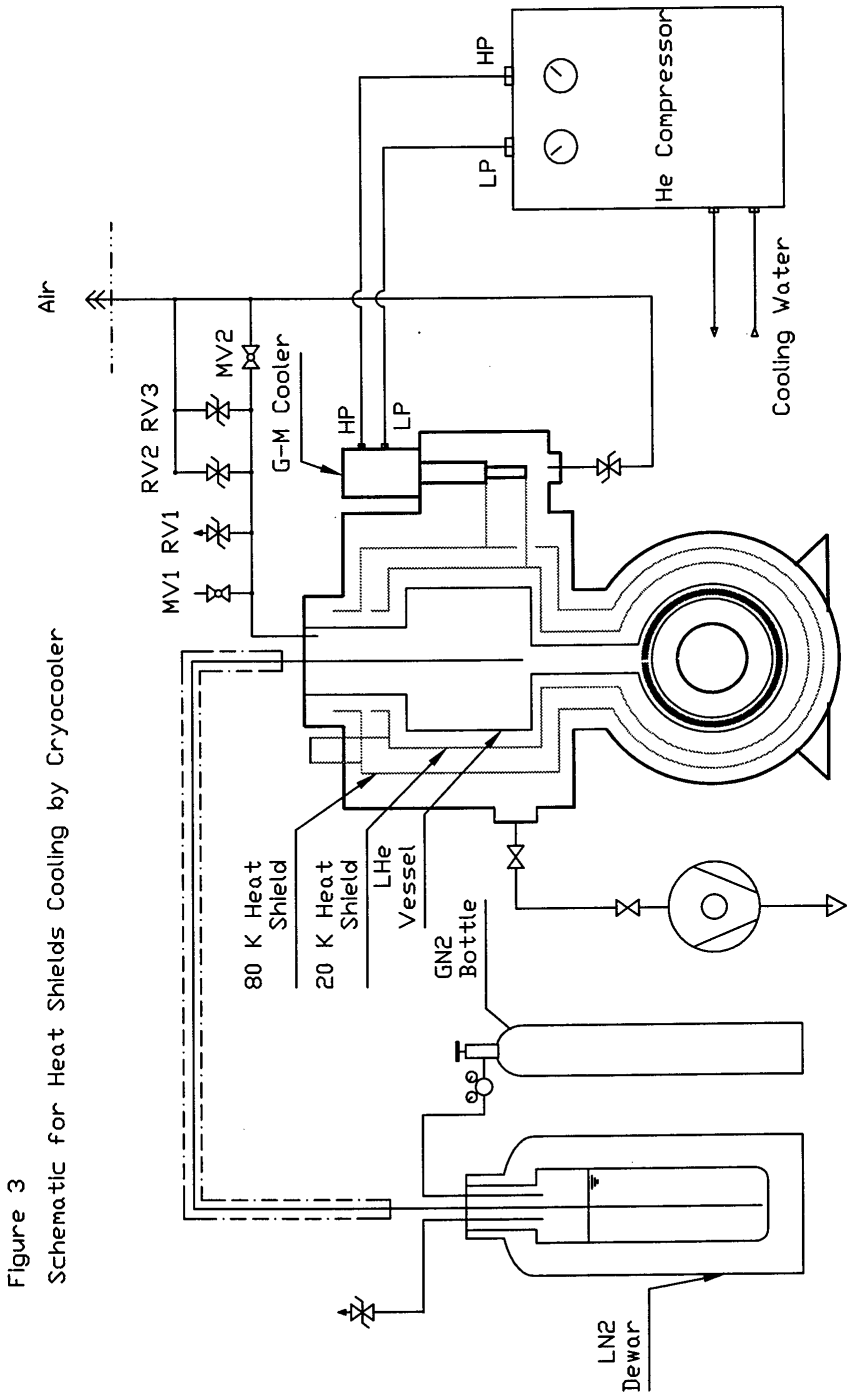

Figure 3
Schematic for Heat Shields Cooling by Cryocooler

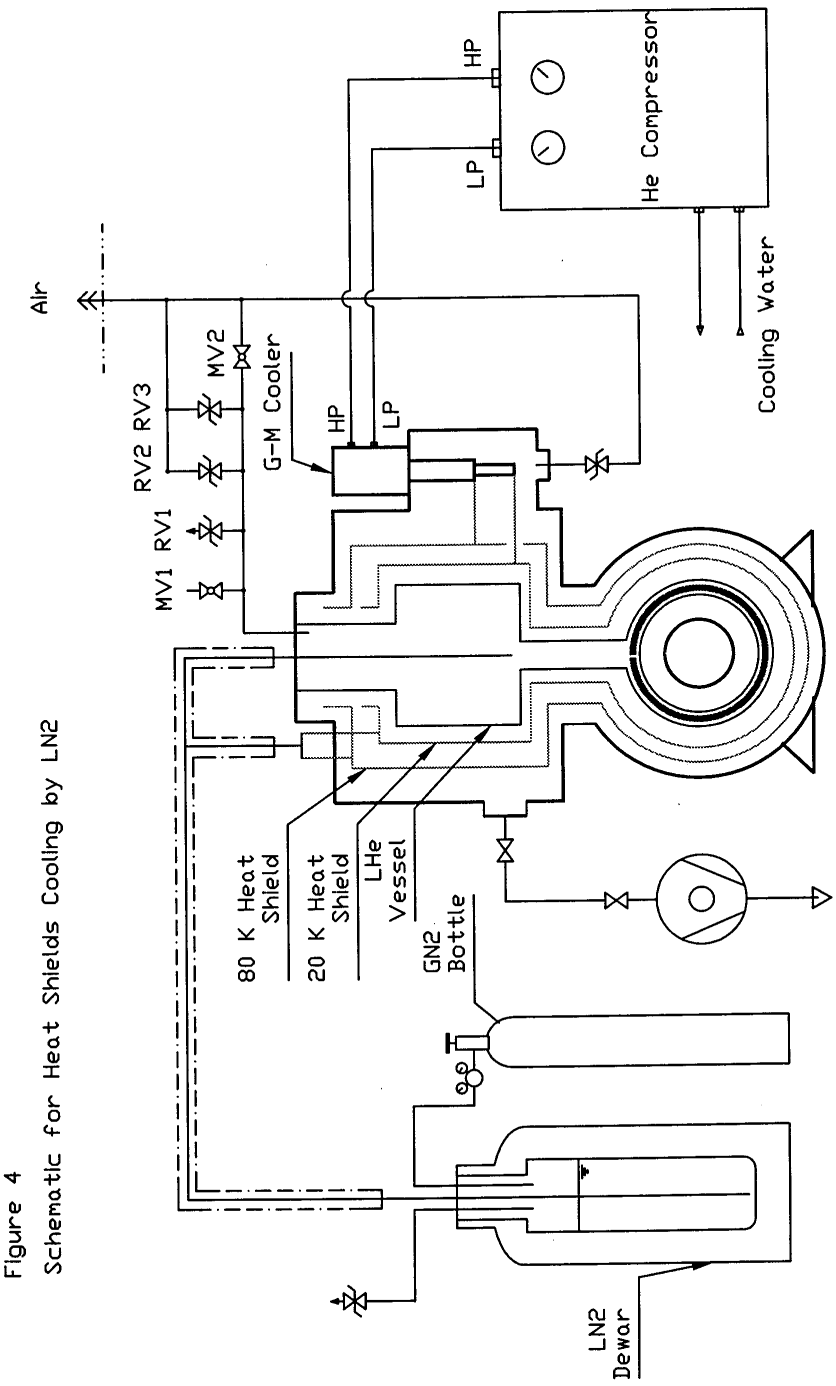

Figure 4
Schematic for Heat Shields Cooling by LN2

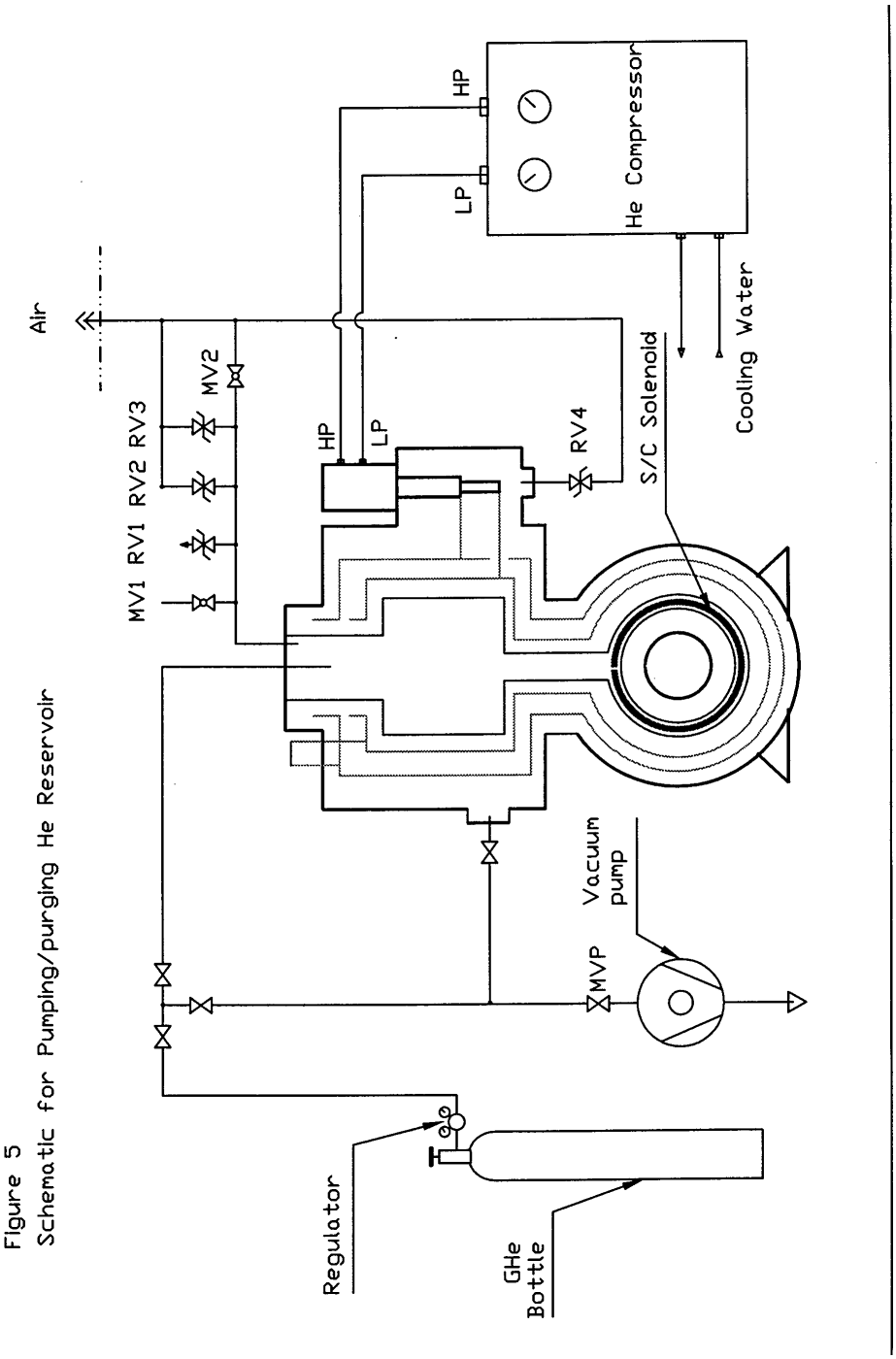

Figure 5
Schematic for Pumping/purging He Reservoir

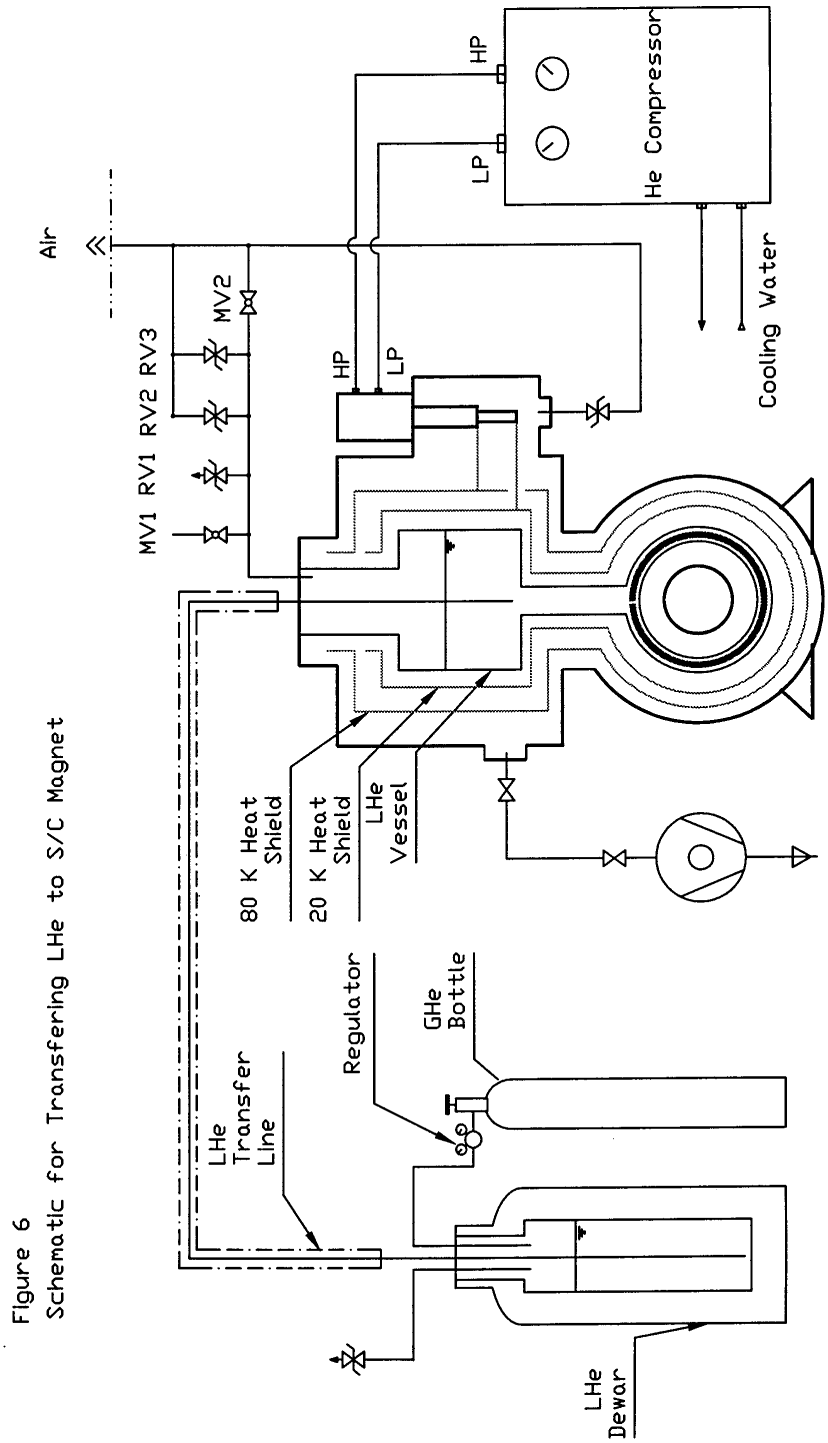

Figure 6
Schematic for Transfering LHe to S/C Magnet

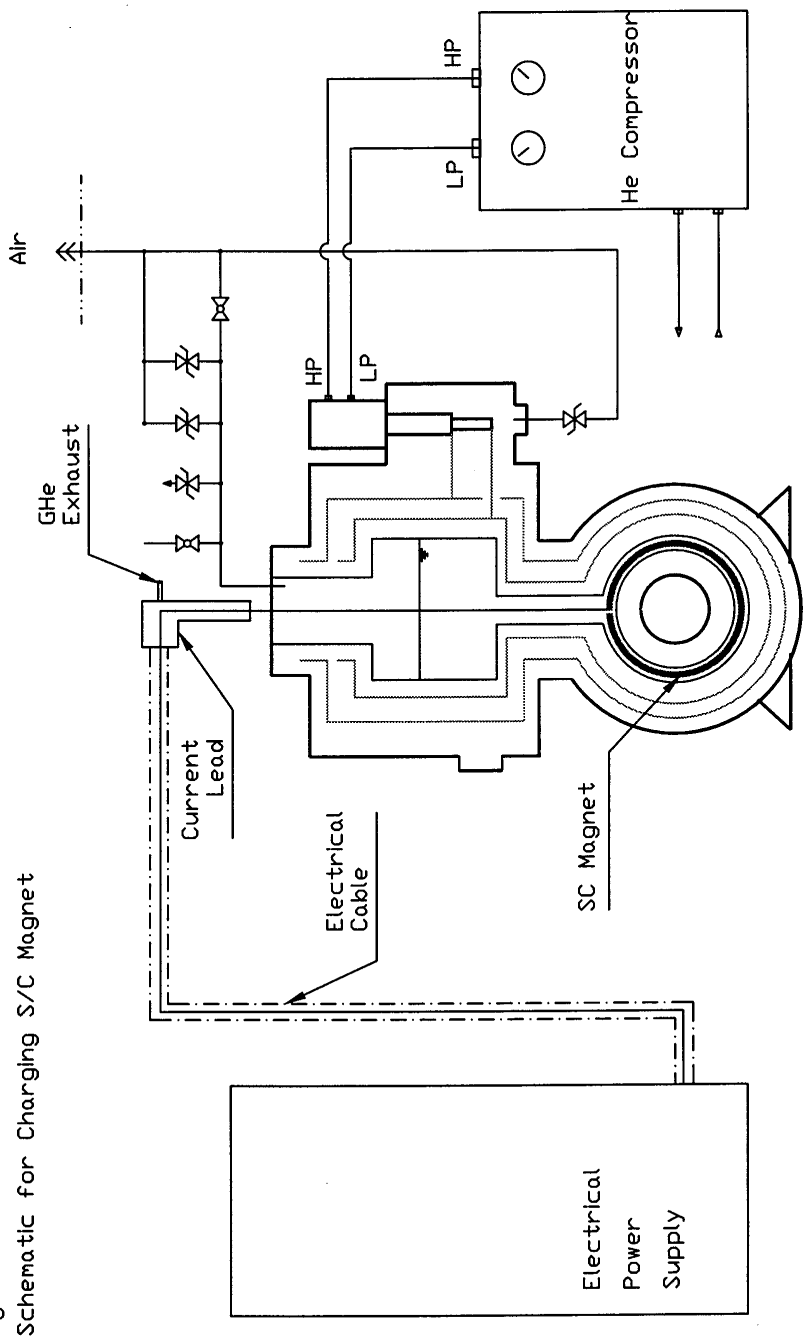

Figure 7
Schematic for Charging S/C Magnet